ENGINEERING DESIGN/CAD

COURSE DESCRIPTION

Engineering Design/CAD* is a course in which students learn the basic concepts of scale drawings and orthographic projections by making simple two- and three-dimensional drawings using manual drafting tools and computer-aided design (CAD). Course content will enable students to make the transition into the use of CAD software by having them make increasingly sophisticated drawings. Student work in teams will culminate in a class project to create a complete set of construction and assembly drawings for a mechanical product.

Prerequisite(s)*:   **None**

Algebra I or Math for Technology II; basic experience with graphical computer interface (may be concurrent)

Recommended Credits: **2**

Recommended Grade Level(s):   **10th, or 11th**

Note: **Course will include 9 to 18 weeks of pencil drawings prior to beginning work on computer aided drawing projects.**

*This course may be offered as a part of the Construction or the Manufacturing sub-cluster, depending upon the student's career focus. The prerequisites for this course are the same in both sub-clusters.

ENGINEERING DESIGN/CAD STANDARDS

1.0   Students will demonstrate proficiency in creating manual two-dimensional scale drawings.

2.0   Students will demonstrate proficiency in creating manual three-dimensional scale drawings.

3.0   Students will use the basic functions of a CAD software program to draw two-and three-dimensional objects.

4.0   Students will demonstrate proficiency in creating sectional and pictorial drawings using a CAD software program.

5.0   Students will use CAD software skills to produce complete sets of project drawings.

6.0   Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

ENGINEERING DESIGN/CAD

STANDARD 1.0

Students will demonstrate proficiency in creating manual two-dimensional scale drawings.

LEARNING EXPECTATIONS

The student will:
1.1   Create accurate and complete manual scale drawings of two-dimensional objects and two-dimensional plans.
1.2   Apply drawing dimensioning rules using basic measurement systems.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
1.1.A Makes scale drawings of given two-dimensional objects, including floor plans and equipment.
1.1.B Annotates drawings with labels and dimensions using basic manual lettering styles and techniques.
1.1.C Creates and completes title blocks on drawings.
1.2.A Applies dimensioning rules, such as avoiding redundancy and dimensioning to hidden lines, dual dimensions, and properly indicated tolerances.
1.2.B Uses basic measurement systems including fractions, decimals, English, and metric.

SAMPLE PERFORMANCE TASKS

- Complete a scale drawing of classroom or computer lab floor plan.
- Complete a scale drawing of football field and surrounding area.
- Complete a scale drawing of fire escape routes for each floor of school building.

INTEGRATION/LINKAGES
Foundation for Industrial Modernization (FIM*). What Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*. Washington, DC: National Coalition for Advanced Manufacturing, 1995. Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995. International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology*. International Technology Education Association. Reston, VA, 2000. Manufacturing Skill Standards Council. *A Blueprint for Workforce Excellence (draft skill standards for manufacturing.)* Manufacturing Skill Standards Council, 2001. Mathematics concepts and skills.

ENGINEERING DESIGN/CAD

STANDARD 2.0

Students will demonstrate proficiency in creating manual three-dimensional scale drawings.

LEARNING EXPECTATIONS

The student will:
2.1   Create complete orthographic projections of simple three-dimensional objects.
2.2   Create complete orthographic projections of complex three-dimensional objects.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
2.1.A   Makes orthographic pencil drawings of simple three-dimensional objects, including appropriate dimensioning and auxiliary and sectional views.
2.1.B   Uses hidden lines to show internal or hidden features of simple three-dimensional objects.
2.2A   Makes orthographic pencil drawings of complex three-dimensional objects, including appropriate dimensioning and auxiliary and sectional views.
2.2B   Uses hidden lines to show internal or hidden features of complex three-dimensional objects.

SAMPLE PERFORMANCE TASKS

- Complete a drawing of custom shaped metal/wooden blocks.
- Complete a scale drawing of the exterior details of a computer monitor.
- Complete a drawing of the teacher's desk.

INTEGRATION/LINKAGES

Foundation for Industrial Modernization (FIM*). What Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*. Washington, DC: National Coalition for Advanced Manufacturing, 1995. Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995. International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology*. International Technology Education Association. Reston, VA, 2000. Manufacturing Skill Standards Council. *A Blueprint for Workforce Excellence (draft skill standards for manufacturing.)* Manufacturing Skill Standards Council, 2001. Mathematics concepts and skills.

ENGINEERING DESIGN/CAD

STANDARD 3.0

Students will use the basic functions of a CAD software program to draw two-and three-dimensional objects.

LEARNING EXPECTATIONS

The student will:
3.1   Perform basic CAD software operations.
3.2   Use standard templates and create new templates for CAD drawing.
3.3   Use a CAD program to draw and dimension simple two-dimensional objects.
3.4   Use a CAD program to draw and dimension orthographic projections of three-dimensional objects.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
3.1   Performs CAD software operations, including creating, saving, opening, filing, plotting/printing drawing files.
3.2 A   Makes drawings using existing templates in a CAD program.
3.2.B   Creates and uses new custom templates in a CAD program.
3.3.A   Makes scale drawings of simple two-dimensional objects with a CAD program.
3.3.B   Annotates, dimensions, and titles scale drawings of two-dimensional objects with a CAD program.
3.4.A   Makes an orthographic projection to scale of three-dimensional objects.
3.4.B   Annotates, dimensions, and titles scale drawings of three-dimensional objects with a CAD program.

SAMPLE PERFORMANCE TASKS

- Create scale drawing of floor plan of school auditorium using a CAD program.
- Use a CAD template to produce simple drawing of uniform characteristics by all class members.
- Create templates for small detail objects (e.g., watch) and large scale drawing (e.g., city map).
- Create an orthographic projection of a calculator using a CAD program.

INTEGRATION/LINKAGES

Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995. International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology*. International Technology Education Association. Reston, VA, 2000.

Manufacturing Skill Standards Council. Mathematics concepts and skills. Computer Science concepts and skills.

ENGINEERING DESIGN/CAD

STANDARD 4.0

Students will demonstrate proficiency in creating sectional and pictorial drawings using a CAD software program.

LEARNING EXPECTATIONS

The student will:
4.1   Create sectional views of moderately complex solid objects or.
4.2   Create pictorial drawings of a group of objects using a CAD program.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
4.1.A Creates sectional views of solid objects using a CAD program.
4.1.B Creates sectional views of assemblies using a CAD program.
4.1.C Combines plane and sectional views to show interior and exterior details of objects in CAD drawings.
4.1.D Selects appropriate scales and CAD grids for drawings.
4.2.A Creates pictorial representation of placement and relative position of a group of objects in CAD drawings.
4.2.B Creates readily identifiable pictorial representation of objects by way of size, shape, shading and color using a CAD program.

SAMPLE PERFORMANCE TASKS

- Draw sectional view of a tape dispenser.
- Draw sectional view of wood-frame wall.
- Draw sectional view of bookcase with shelves and doors.
- Draw interior and exterior sectional views of a stapler.
- Create pictorial drawing of computer components of desk.
- Create pictorial drawing of assorted furniture in room.
- Create pictorial drawing of placement of computer card inside computer case.

INTEGRATION/LINKAGES

Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995. International Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology.* International Technology Education Association. Reston, VA, 2000. Manufacturing Skill Standards Council. Mathematics concepts and skills. Computer Science concepts and skills.

ENGINEERING DESIGN/CAD

STANDARD 5.0

Students will use CAD software skills to produce complete sets of project drawings.

LEARNING EXPECTATIONS

The student:
5.1   Draw individual components of a project using a CAD program.
5.2   Make assembly drawings including exploded assemblies, for a project, using a CAD program.
5.3   Create a bill of materials for a project using a CAD program.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
5.1.A   Identifies the unique components of a project.
5.1.B   Chooses the best representation (e.g., plan, orthographic, or pictorial) for each component in a project and complete the drawings using a CAD program.
5.1.C   Draws individual components of a project.
5.2.A   Draws the completed assembly for a project using a CAD program.
5.2.B   Draws the exploded assembly for a project using a CAD program.
5.2.A   Makes a list of types and quantities of raw materials required for a project.
5.2.B   Makes a list of types and quantities of finished-goods components required for project.

SAMPLE PERFORMANCE TASKS

Based on a proposed, moderately complex project, the student will (in groups):
- Decide how many and what types of drawings are needed and which group member will be responsible for each drawing.
- Produce the assigned drawing.
- Collectively examine the drawings for consistency, compatibility and accuracy.
- Make a presentation to a perspective user and defend the design and quality of the drawing set.

Example projects might include an executive desk, a battery-powered electric car, or a folding chair.

INTEGRATION/LINKAGES

Foundation for Industrial Modernization (FIM). *What Manufacturing Workers Need to Know and Be Able to Do: National Voluntary Skill Standards for Advanced High Performance Manufacturing*. Washington, DC: National Coalition for Advanced Manufacturing, 1995.
Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995. International

Technology Education Association. *Standards for Technological Literacy: Content for the Study of Technology.* International Technology Education Association. Reston, VA, 2000. Manufacturing Skill Standards Council. *A Blueprint for Workforce Excellence (draft skill standards for manufacturing.)* Manufacturing Skill Standards Council, 2001. Mathematics concepts and skills. Computer Science concepts and skills.

ENGINEERING DESIGN (CAD)

STANDARD 6.0

Students will demonstrate leadership, citizenship, and teamwork skills required for success in the school, community, and workplace.

LEARNING EXPECTATIONS

The student will:
6.1   Exhibit positive leadership skills.
6.2   Participate in SkillsUSA-VICA as an integral part of classroom instruction.
6.3   Assess situations and apply problem-solving and decision-making skills to particular client relations in the community, and workplace.
6.4   Demonstrate the ability to work cooperatively with others in a professional setting.

PERFORMANCE STANDARDS: EVIDENCE STANDARD IS MET

The student:
6.1   Demonstrates character, leadership, and integrity using creative and critical-thinking.
6.2.A Applies the points of the creed to personal and professional situations.
6.2.B Participates and conducts meetings and other business according to accepted rules of parliamentary procedure.
6.3.A Analyzes situations in the workplace and uses problem-solving techniques to solve the problem.
6.4.A Participates in a community service project.
6.4.B Assists with an officer campaign with Tennessee SkillsUSA-VICA.

SAMPLE PERFORMANCE TASKS

- Create a leadership inventory and use it to conduct a personal assessment.
- Participate in various SkillsUSA-VICA programs and/or competitive events.
- Evaluate an activity within the school, community, and/or workplace and project effects of the project.
- Implement an annual program of work.
- Prepare a meeting agenda for a SkillsUSA-VICA monthly meeting.
- Attend a professional organization meeting.
- Participate in the American Spirit Award competition with SkillsUSA-VICA.

INTEGRATION LINKAGES

SkillsUSA-VICA, *Professional Development Program,* SkillsUSA-VICA, Communications and Writing Skills, Teambuilding Skills, Research, Language Arts, Sociology, Psychology, Math, Math for Technology, Applied Communications, Social Studies, Problem Solving, Interpersonal Skills, Employability Skills, Critical-Thinking Skills, SCANS (Secretary's Commission on

Achieving Necessary Skills), Chamber of Commerce, Colleges, Universities, Technology Centers, and Employment Agencies

ENGINEERING DESIGN/CAD

SAMPLING OF AVAILABLE RESOURCES

Basic Technical Drawing. Glencoe, 2001.
Mechanical Drawing. Glencoe, 1997.
Principles of Engineering Graphics. MacMillan, 1994.
Principles of Engineering Graphics, 2nd Edition. Prentice Hall, 1994.
Foundation for Industrial Modernization (FIM). *National Occupational Skill Standards for Computer Aided Drafting and Design (CADD)*. Washington, DC: FIM, 1995.